Persistence, Shocks, and Reversal:

Evidence from China since the Neolithic Revolution, 5000 BCE-2010 CE

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Motivation

- *Neolithic Revolution* ⇒ start of statehood
  - North & Thomas (1977); Smith (1978); Mayshar et al. (2022)
- State capacity ⇒ long-term development
  - Besley & Persson (2009); Putterman & Weil (2010); D'Arcy et al. (2024)

Questions:

- Dynamic linkage: *Neolithic Revolution* ⇒ Statehood ⇒ Development?
  - Shocks → facilitating & weakening the persistence?

Our Setting: China Proper, 5000 BCE–2010 CE

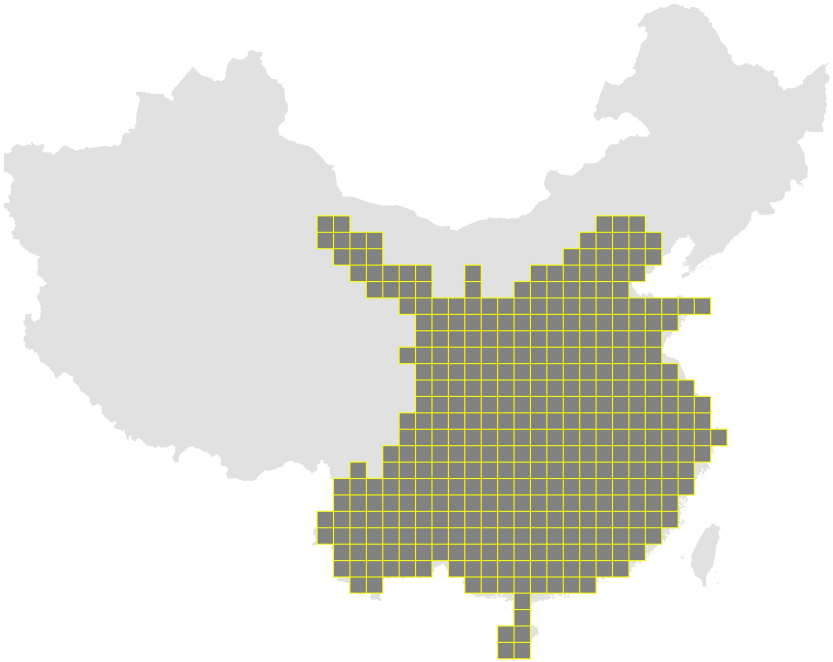


Figure 1: China Proper, 385 cells (100km × 100km)

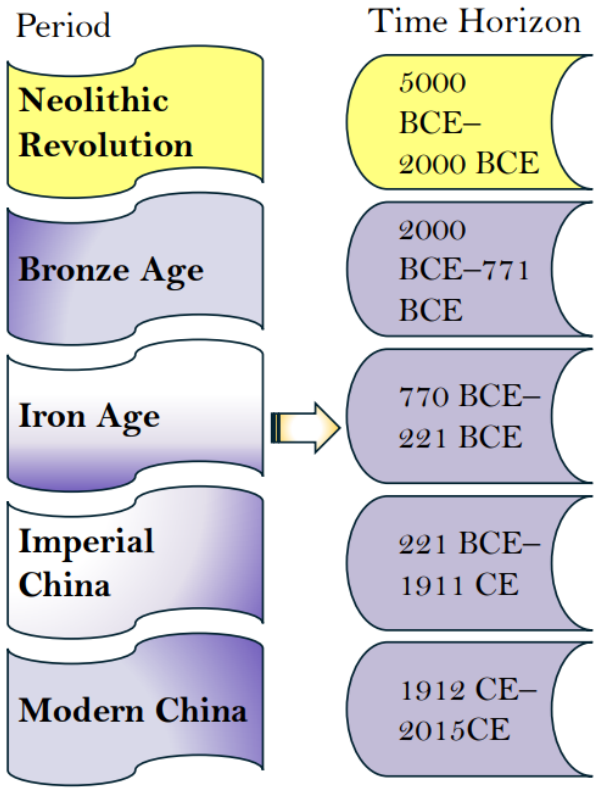


Figure 2: Time horizon

- Independent origin of Neolithic Revolution (Diamond & Bellwood, 2003)
- Archaeological findings + historical population census (Cao, 2001; Liu & Chen, 2012)
- Complete trajectory of institutional evolution (Zhao, 2015; Düben & Krause, 2023)

What we have done

$$\%\ Pop_i = \alpha + \beta \times \%\ NeoSite_i + \boldsymbol{X}_i + \varepsilon_i$$

- $\%\ NeoSite_i$: each cell's share of Neolithic sites, 5000 BCE-2000 BCE ▸ Sources
- $\%\ Pop_i$: each cell's share of population (sites), 2000 BCE-2010 CE ▸ Validity

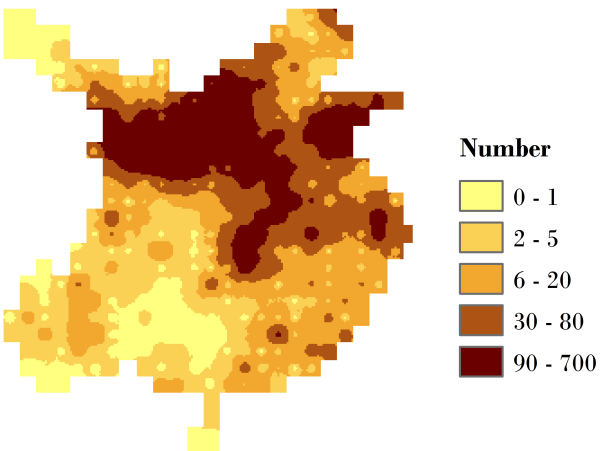


Figure 3: Site density, 5000-2000 BCE

Source: > 80,000 sites recorded in the *Atlas of Chinese Relics*

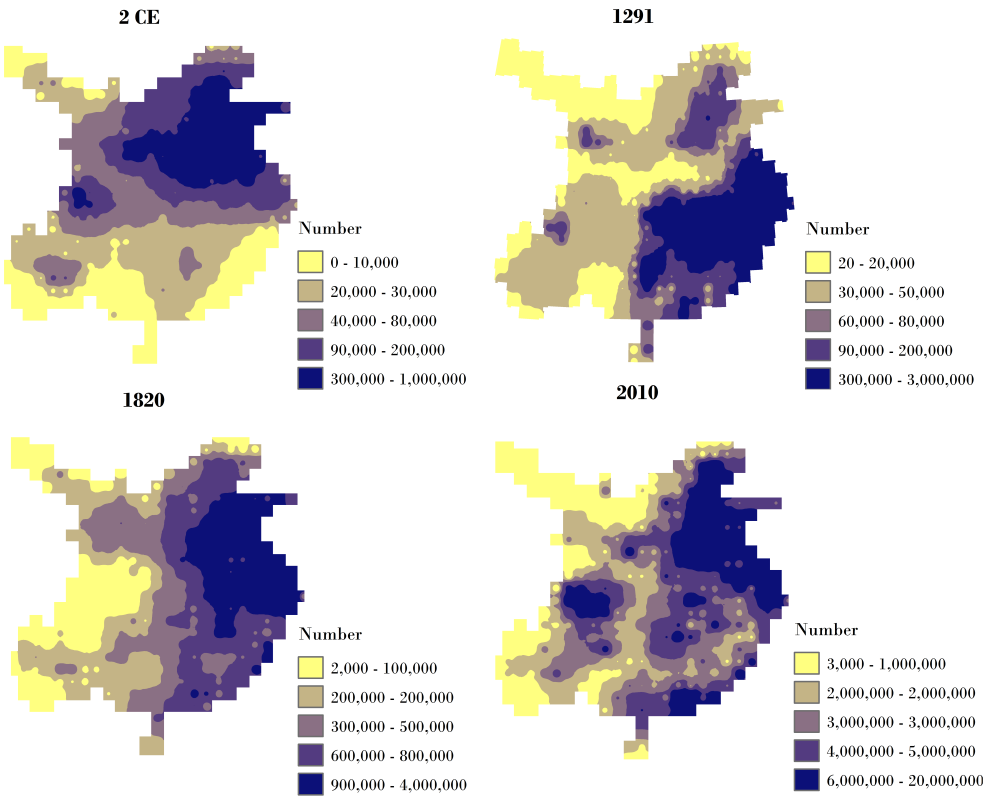
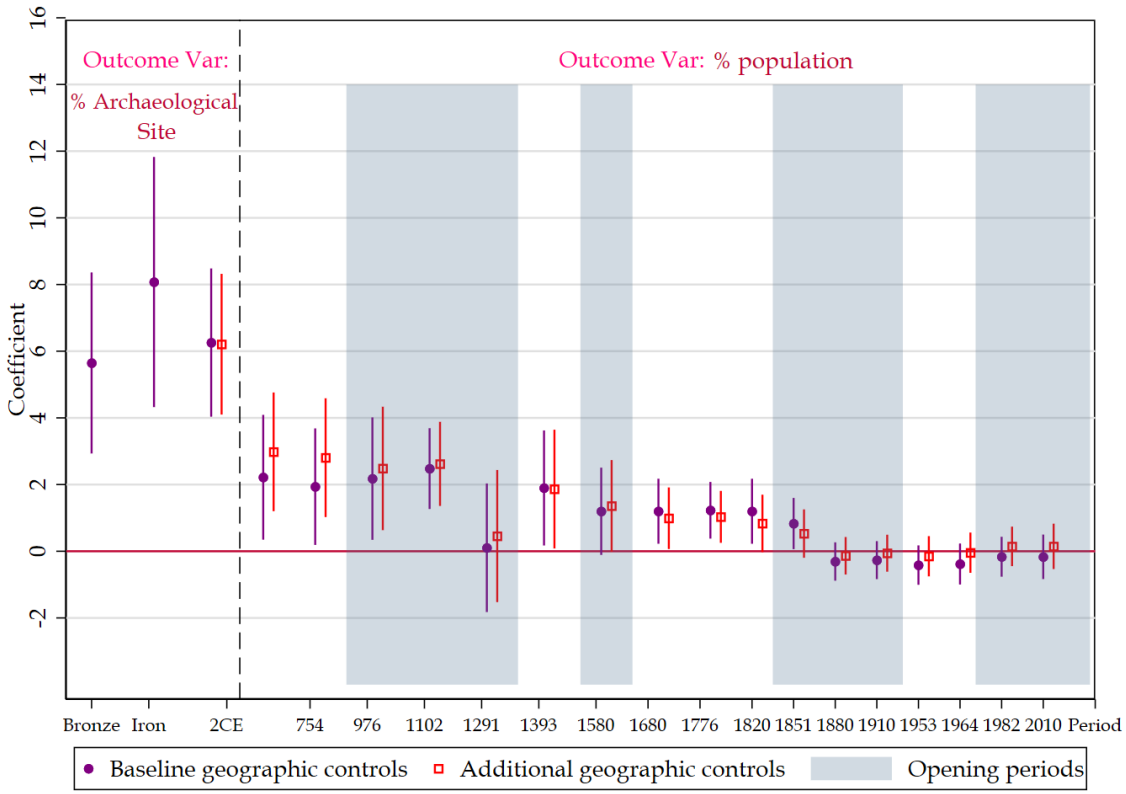


Figure 4: Population density, 2 CE-2010

Findings

- "Neolithic hotspots" ⇒ more prosperous in most of the subsequent 4 millennia
  - ▸ rank correlation
- Weakened whenever opening to maritime trade after the 8th century



Note: Baseline controls include latitude, longitude, Holocene climate, elevation, terrain ruggedness, distances to the earliest Yellow River and Yangtze River, distances to the earliest coastline, agricultural suitability indices for rice and millet; Additional controls include agricultural suitability indices for wheat, maize, and sweet potatoes, and distances to the changing routes of the major rivers.

DiD Results ⇒ Autarky vs. Opening

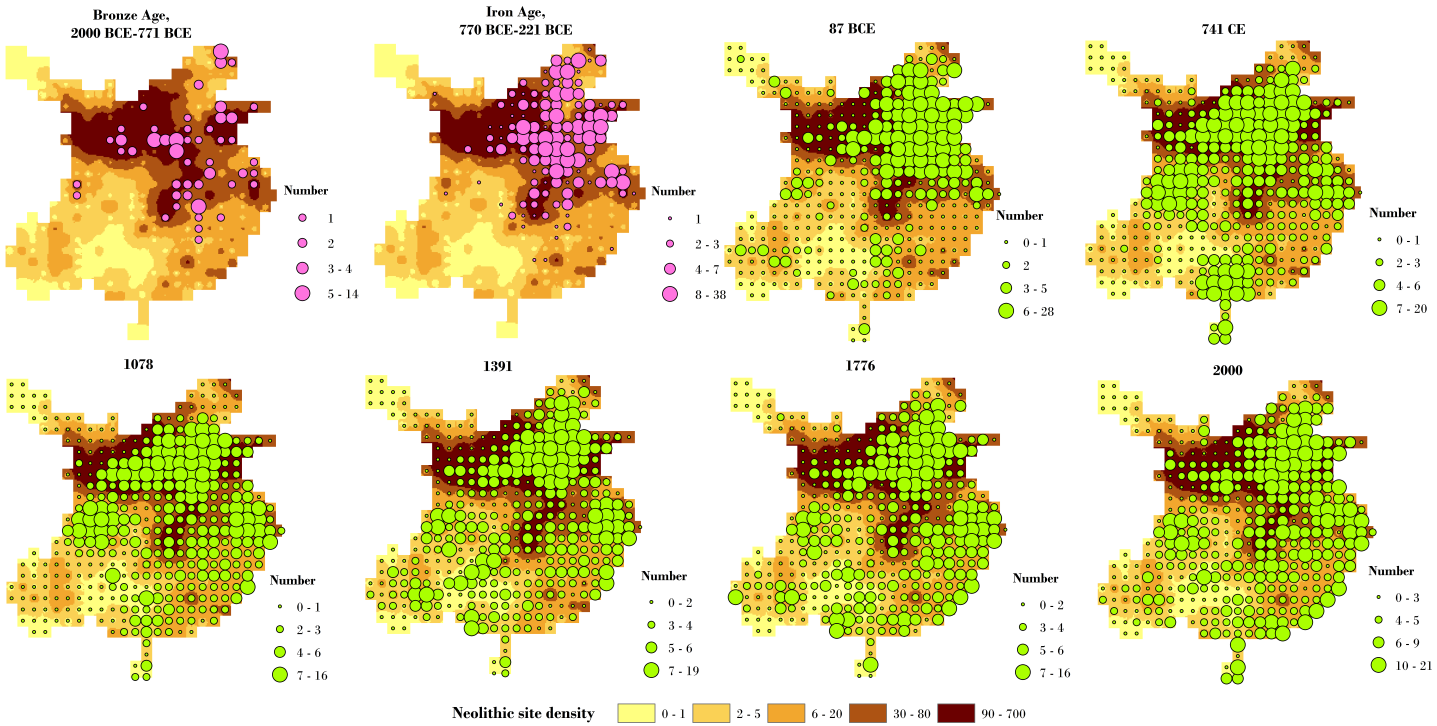
$$\%Pop_{i,t} = \beta \times \%NeoSite_i \times \text{Opening}_t + \boldsymbol{X}_i \times \text{Opening}_t + \alpha_i + \gamma_t + \varepsilon_{i,t} \qquad (1)$$

% Population (2 CE–2010)				
	Full Sample		Excluding cells without Neolithic site	
	(1)	(2)	(3)	(4)
% Neolithic site × Opening	-1.754***	-1.038***	-1.708***	-1.074***
	(0.344)	(0.268)	(0.356)	(0.273)
Controls × Opening	N	Y	N	Y
Grid-Cell Fixed Effects	Y	Y	Y	Y
Period Fixed Effects	Y	Y	Y	Y
Observations	6,161	6,161	4,710	4,710
R-squared	0.552	0.595	0.521	0.572

Note: Controls include latitude, longitude, Holocene climate, elevation, terrain ruggedness, distances to the (changing routes of) Yellow River and Yangtze River, distances to the earliest coastline, agricultural suitability indices for rice and millet.

Mechanisms for persistence

- "Neolithic hotspots" ⇒ higher density of state institutions after 2000 BCE



- Public goods provided by the state (↑)
  - Hydraulic projects ▸ hydraulic
  - Transportation networks (density and distance) ▸ transportation
  - Ideological orthodoxy & schooling ▸ ideology

Explaining the weakening effect of opening

Rise of "trade hotspots" → coastal regions far away from the "Neolithic hotspots" & less state presence ▸ trade ports

- Historical trade ports: "Shibosi" system (7th-14th century)
  - Contingent on the central government
- "Treaty Ports" system after the 1840s ⇒ Permanent impact
  - Introduction of Western legal & fiscal institutions ⇒ Modern factors of production ▸ modernity
    - Custom system: tariff
    - Industrial & financial capital: modern firms and banks
    - Human capital: modern colleges
    - Transportation technology: steamship stations

Contribution

1. Statehood and Long-term Economic Development

- Becker et al. (2016); Flueckiger et al. (2022); D'Arcy et al. (2024); Ma (2024)
- Excessively long statehood ⇒ prohibit growth (Hariri, 2012; Olsson & Paik, 2020)
- Our Study: modern institutions ⇒ "Reversal of Fortune" (Acemoglu et al., 2002, 2005; Mokyr, 2005; Jia, 2014)

2. Impact of the Neolithic Revolution

- Cross-country evidence: Hibbs & Olsson (2004); Putterman & Weil (2010); Galor & Özak (2016); Olsson & Paik (2017); Bowles & Choi (2019)
- Our Study:
  - More granular evidence + long-term dynamics & underlying drivers

3. Locational fundamentals & path dependence in determining spatial equilibria

- Davis & Weinstein (2002); Bleakley & Lin (2012); Henderson et al. (2018)
- Our study: the initial state exogenously shaped by locational fundamentals + institutional change after mid-19th century → path dependence

Appendix: Validity of using Site Density to proxy Population Density

Correlation: Site density (206 BCE-220 CE) and population density (2 CE)

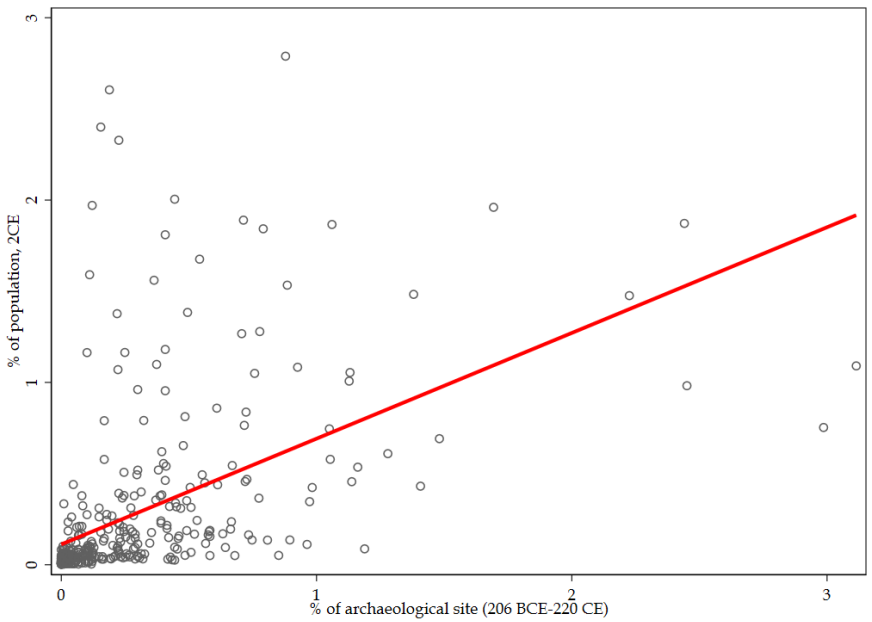


Figure 5: Raw correlation

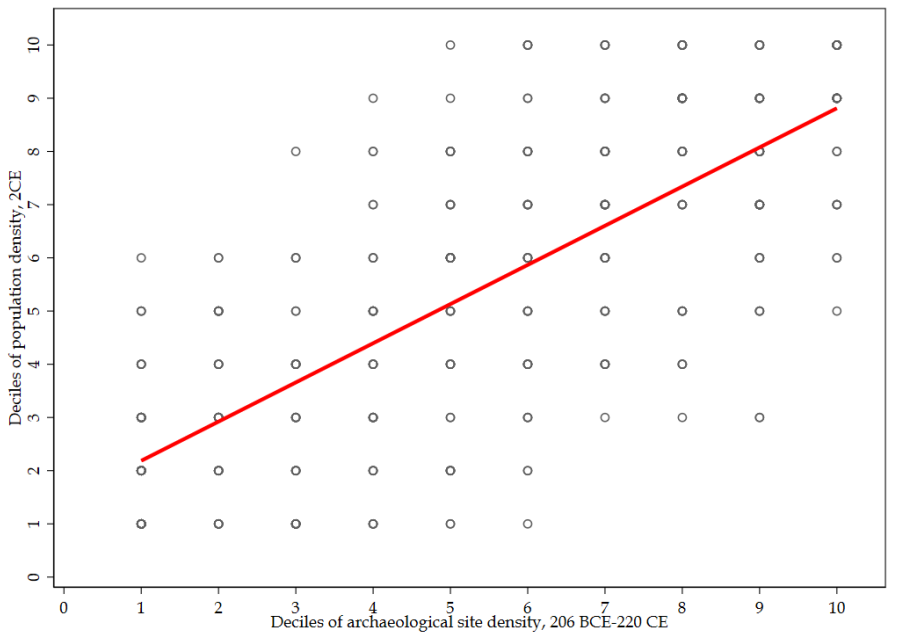
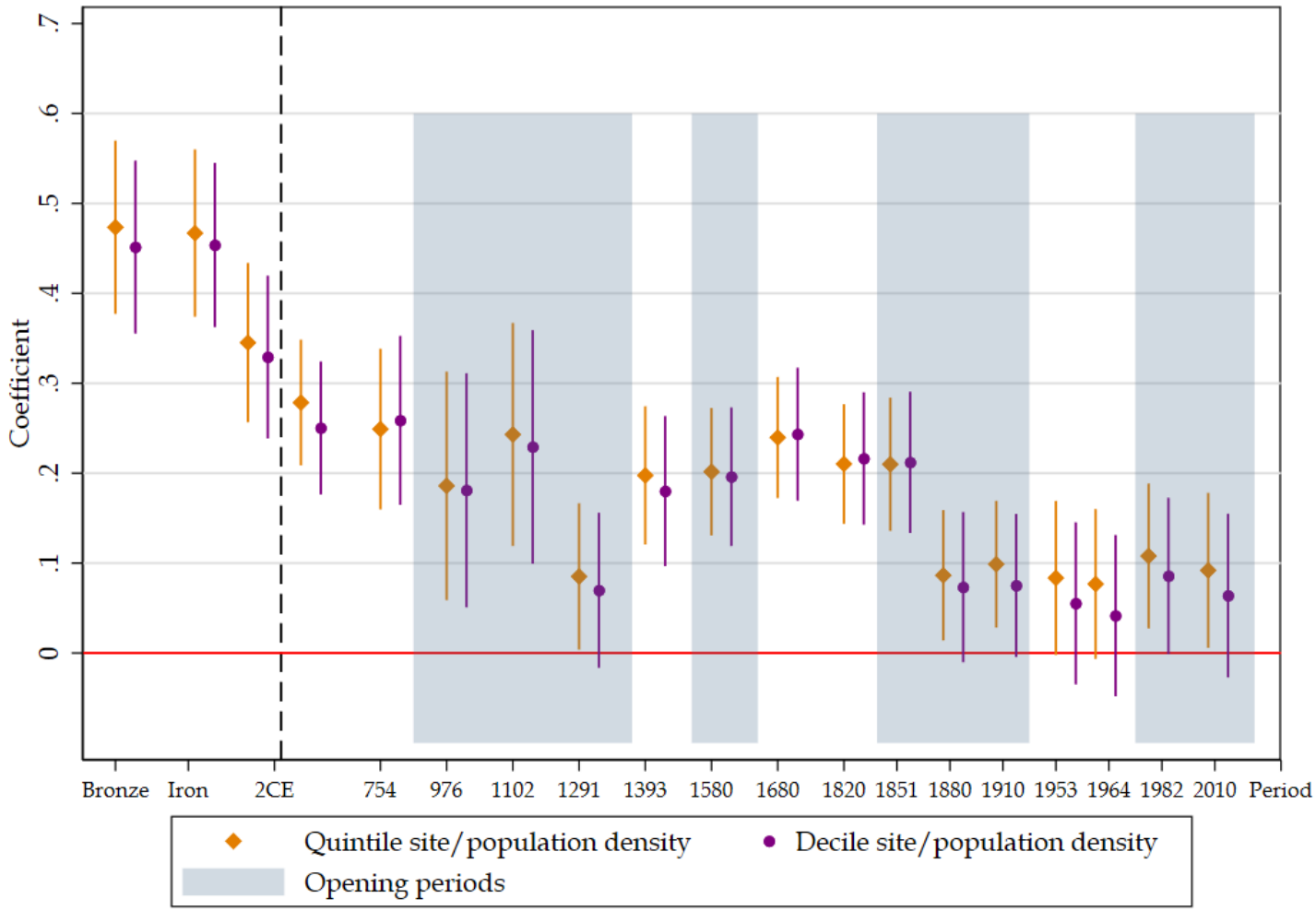


Figure 6: Rank correlation (10 deciles)

Appendix: Persistence of the Neolithic Pattern

- Rank correlation: the quintiles & deciles of site + population density



Explaining Persistence: Hydraulic Projects

- 1(Having hydraulic projects) in 2 CE/754
  - History of Agricultural Water Conservancy in China (Wang & Zhang, 1990)
- Town density with Chinese names related to hydraulic projects in 1820 (CHGIS V6)
  - “堰” (weir); “陂/塘” (ponds); “堤/坝” (dam); “渠” (canal); “井” (well)

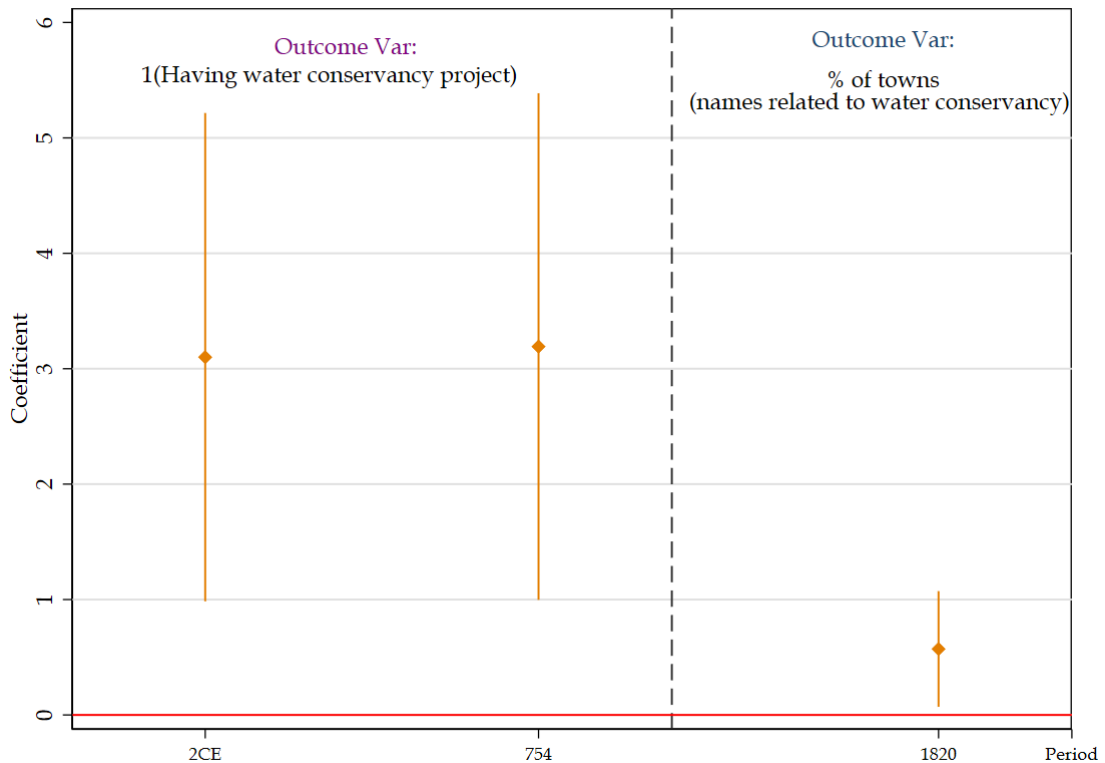
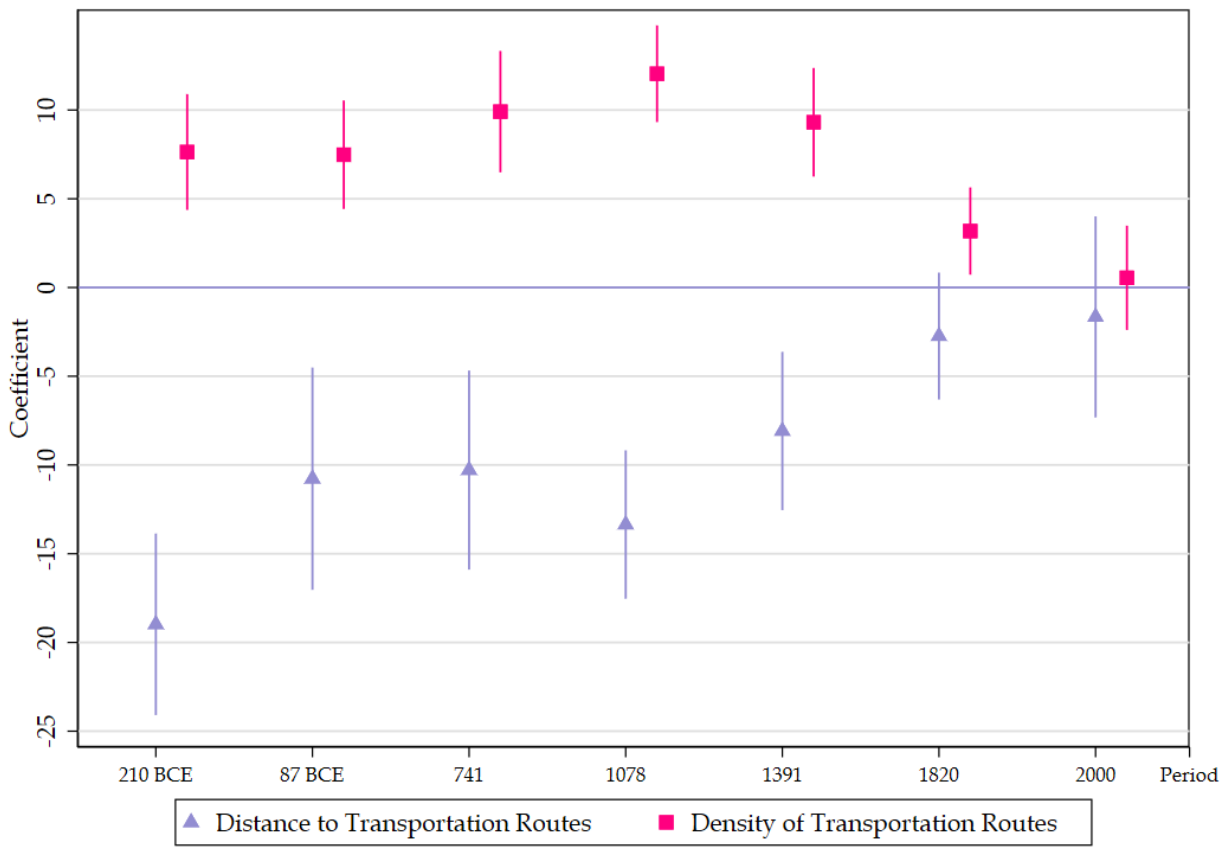


Figure 7: Regressing hydraulic projects on % Neolithic site

Explaining Persistence: Transportation Network

- Two proxies for access to the official transportation network, 221 BCE-2000 CE
- Source: Cheng & Hsu (1980)
  - Density measure (in purple)
  - Distance measure (in blue)

Figure 8: Accessibility to transportation network and % Neolithic site, 210 BCE-2000 CE



Explaining Persistence: Ideological Orthodoxy and Schooling

- No. Confucian sage temples by 1820
- No. Official schools by 1820
  - Sources: Comprehensive Geographic Gazetteer of the Great Qing Unification (1820), Ji (1996)

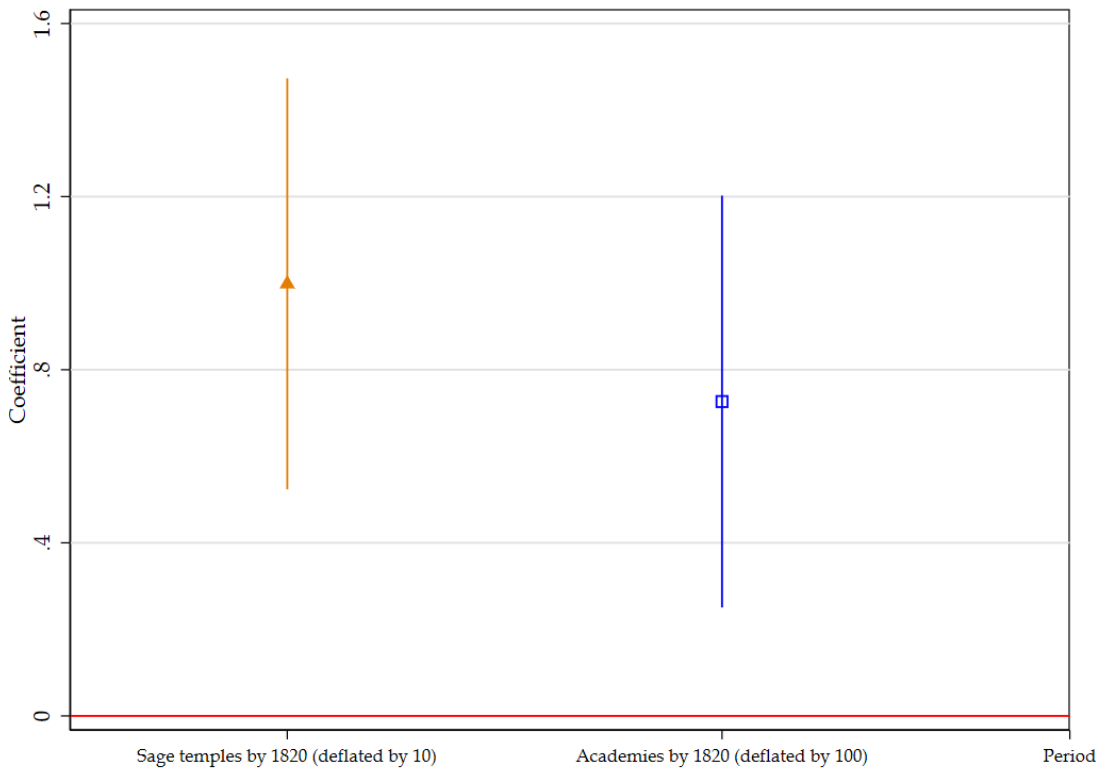


Figure 9: Regressing Confucian sage temples and official schools on % Neolithic site

Accounting for the "Reversal of Fortune" after 1840s

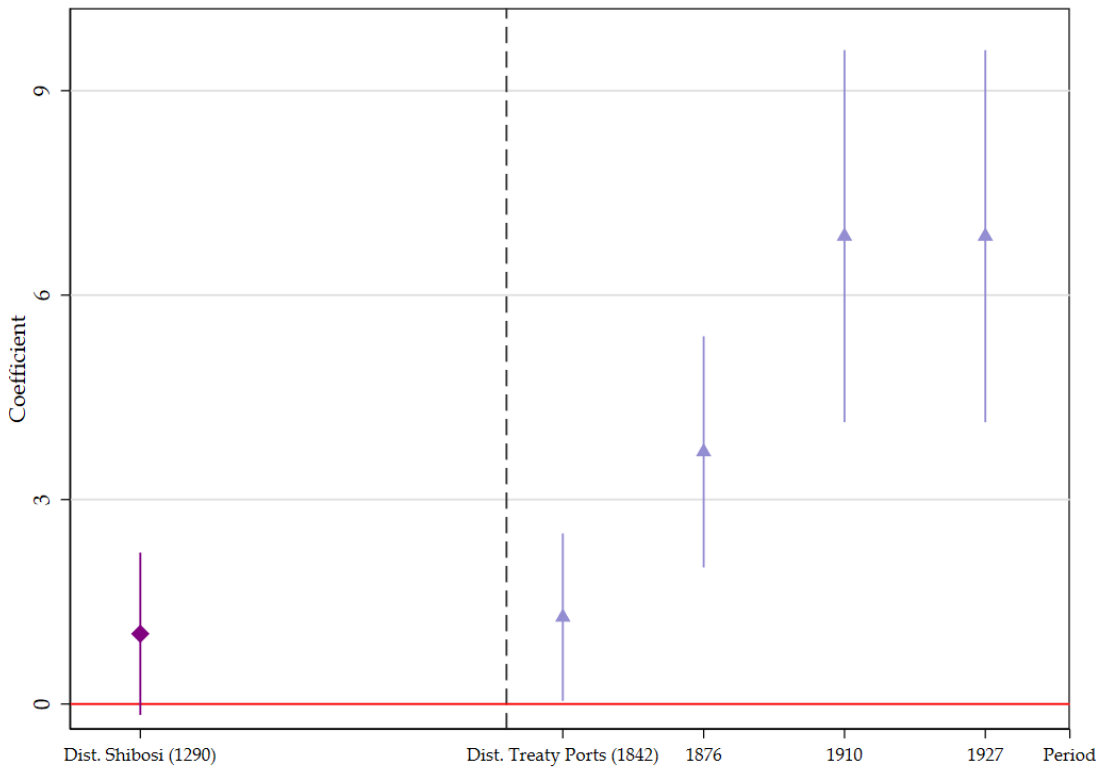
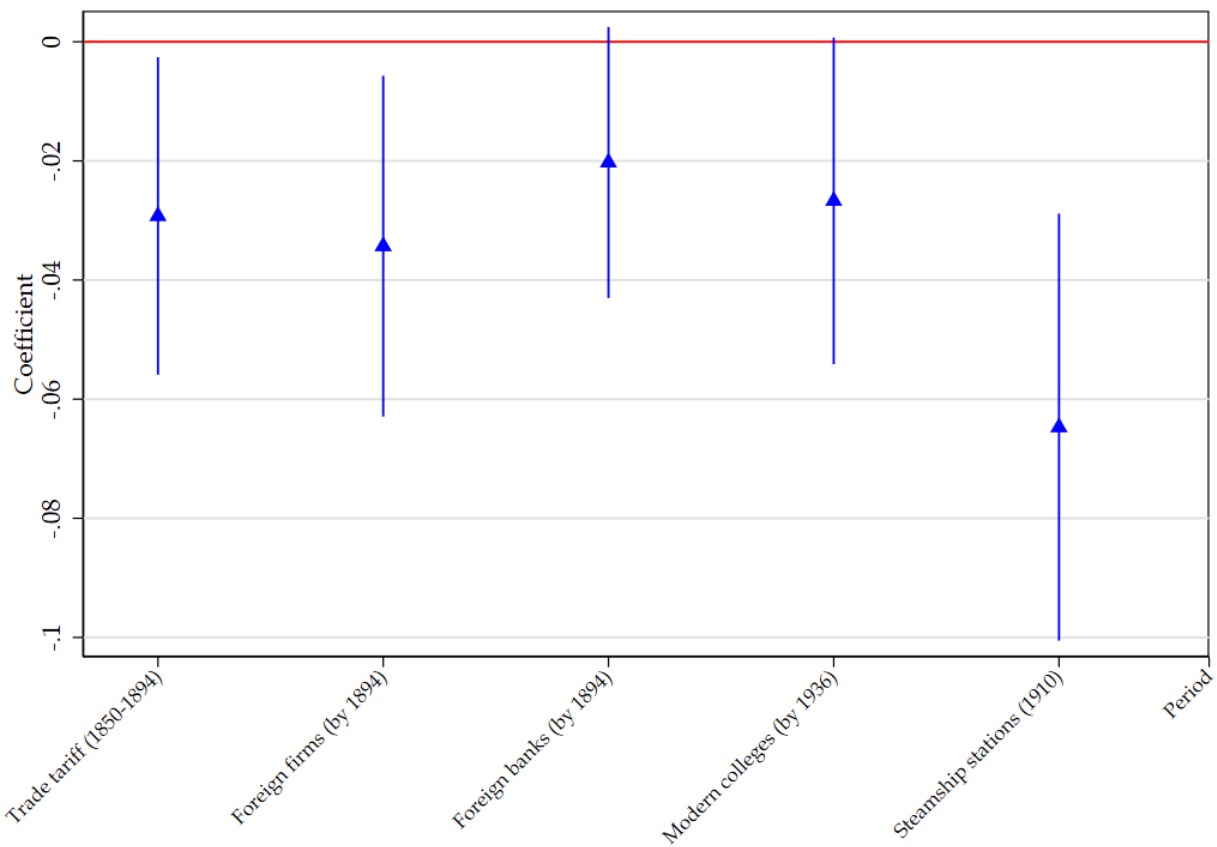


Figure 10: Regressing distance to historical trade ports (1291) and Treaty Ports (1840-1927) on % Neolithic site

Accounting for the weakening effects of opening

⇒ Predicting modern institutions & factors introduced after the 1840s

- Modern custom system
- Modern industrial & financial capital
- Modern human capital
- Modern transportation technology



Appendix: list of robustness check

- Additionally controlling war frequency (China's Military History Editorial Committee, 2003)
- Additionally controlling for the immigration index (Bai, 2022 IER)
- Using archaeological site density in Paleolithic China (earlier than 8000 BCE) as a placebo
- Dealing with Spatial correlation among Residuals $\rightarrow$ Conley (1999) standard errors
- Excluding Sub-Samples: Excluding the Southeastern Coastal Region + Lingnan Region + Yungui Region (Skinner, 1977; Fernández-Villaverde et al., 2023)
- Excluding the periods 1851, 1880, 1964, and 1982 (1-by-1 & jointly)
- Reverse causality of site excavation: no significant relationship between site density and contemporary prosperity